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A Low-Cost 3D Design Process: Exploring Alternatives to Capture, Process, and Design using 3D Data

Kristen D. Morris
University of Missouri, morriskd@missouri.edu

Lida Aflatoony
University of Missouri

Abby Romine
University of Missouri, acryt3@mail.missouri.edu

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Kristen Morris, Lida Aflatoony, Abby Romine, University of Missouri, USA

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The purpose of this exploratory project was to establish a cost-effective method to capture 3D body scan data and process the data in to 3D avatars that can be used for a variety of end purposes such as 3D design in Computer Aided Design software (CAD) and developing custom half-scale dress forms that can be used as a tool for design. Traditionally, the technology and software required to complete this process can be very cost prohibitive, often ranging from $25,000 to over $100,000 for educators. Cost can be a limitation for the adoption of these tools in educational institutions (including K-12) as well as by independent designers and small businesses. These technologies may open up the 3D CAD process to a variety of end-users. This research builds on previous studies by Plummer and Sanders (2016) who explored using accessible hardware and cost-effective design software as alternative methods for CAD apparel patternmaking. They created patterns by hand in half-scale, digitized the pattern using simple office scanners, increased the patterns into full scale in Adobe Illustrator or Photoshop, applied engineered prints, and printed markers of digitally printed fabrics. Vuruskan and Ashdown (2017) established the groundwork of developing a half-scale dress form from 3D body scan data using low-cost materials such as ½ inch open cell foam. The use of half-scale dress forms has a long history in education (Vuruskan & Ashdown, 2017) and by practitioners such as Charles James (Koda & Reeder, 2014) as tool to aid in design. Although the half-scale dress form they created was made of low-cost materials, they still used fairly inaccessible tools to create the end product (e.g., a Human Solutions 3D body scanner and Geomagic to process the data).

Methods

New tools which are easily accessible at low costs are now available which can be used to capture, process, and design in 3D. In this research, we investigated the issues of using alternative hardware and software to develop digital body models from 3D body scan data that may be used as avatars to generate apparel patterns and develop half-scale dress forms. Since Fall 2017, the researchers have explored multiple technological options. The exploration revealed many possible different technologies. Through trial and error, the researchers determined the best collection of tools to achieve the apparel-related end goals.

Results

The process of creating and working with 3D body scan data include three parts, a) capturing the 3D object, b) processing the 3D object, and c) designing with the 3D object.

Capturing the 3D object. To capture the 3D object the researchers explored using a Structure Sensor by Occipital, Inc. (https://structure.io). The device connects to an iPad as the computing platform and is the first 3D scanner for mobile devices. The Structure Sensor is a structured light 3D sensor and costs $500 for the scanner and software and $600 for an iPad. The advantages of this scanner is that it is portable and small, has a long battery life, can capture data

through clear objects, and capture data at all angles. However, we have observed some variability in scanning quality which appears to be dependent on the ambient lighting. The accuracy can range from +/- .5mm to 30mm, whereas the Size Stream scanner accuracy is +/- 5mm. Scanning with the Structure Sensor can take about 15 to 30 seconds as you walk around the subject. The output of the 3D triangular polygon mesh is less detailed than that of the booth scanners. Finally, the Structure Sensor does not extract body measurements. If this is a desired outcome of capturing 3D data, a supplementary application is necessary to extract measurements.

Processing the 3D object. Processing the 3D scans is a necessary part of the 3D design process to transform 3D data into 3D avatars useable in image editing applications. To clean, remove extraneous data points, fill holes, edit the mesh, and reduce or re-mesh the object, we traditionally used Geomagic Wrap ($2850 perpetual license for education). In this study, we explored Autodesk Meshmixer software (free and open source) which is a robust software with a user-friendly interface that is easy to learn. Mesh Lab (http://www.meshlab.net) which is also free similarly has these capabilities, but is less feature-rich and more difficult to navigate.

Designing in 3D. Various software may be used to design in 3D from the processed 3D avatar. To create half-scale dress forms, the researchers used Autodesk Fusion 360 (free for 3-year trial and $310/year after trial) to resize, cut, and mirror the cleaned body scan data to look like a dress form. Using Slicer, an add-in for Fusion 360, the researchers sliced the dress from into ½ inch slices (the size of the foam sheet). The outcome is a series of slices in a vector-based file that can be used to cut the foam using a laser cutter or printed and cut from foam by hand. The 3D avatar is also usable in 3D modeling or CAD patternmaking software. 3D modeling software such as Rhino (https://www.rhino3d.com) and Autodesk 3D Studio Max (https://www.autodesk.com) may be lower-cost alternatives to CAD patternmaking software, such as Optitex (~ $380 per year for education). Rhino ($195 per year for education) is good for creating design lines with precision and has the capability to flatten patterns from the 3D form through the Squish feature. Likewise, 3D Studio Max (free for 3-year trial and $1505/year after trial) could alternatively be used for 3D design. It features tools that similarly replicate those of Optitex, and allow for life-like material finishes. However, the process of creating apparel patterns requires a slightly different approach to design than traditional patternmaking which can take some patience to learn and require that the user has excellent knowledge of patternmaking principles to critically assess the pattern shapes generated in these software.

Discussion and Conclusion

The methods described in this research have the potential to reduce the cost of designing in 3D with body scan data by nearly 1/10th of the original expense, making it more possible for educational institutions at all levels and small businesses to be able to capture, use, and design with 3D data. This system is, however, not perfect and there are disadvantages which should weigh into the decision to embark on a new 3D design process. The hardware and software are not created explicitly for apparel so some of the features lack utility for apparel design. Designers interested in trying out these applications for apparel design should have a strong background in patternmaking. Overall, this research is a study into possible design alternatives that may change or enhance the CAD process.

References

Koda, H., & Reeder, J. (2014). *Charles James: Beyond fashion*. Yale University Press.

Plummer, B. & Sanders, E. A. (2016). Practical Application of Half-Scale Patterning for Online Digital Textile Design Procedures. *Proceedings of the International Textile and Apparel Association Annual Conference.* Vancouver, British Columbia.

Vuruskan, A., & Ashdown, S. P. (2017). Modeling of half-scale human bodies in active body positions for apparel design and testing. *International Journal of Clothing Science and Technology*, *29*(6), 807-821.